

# Psychological Bulletin

EDITED BY

SHEPHERD I. FRANZ, GOVT. HOSP. FOR INSANE

HOWARD C. WARREN, PRINCETON UNIVERSITY (*Review*)

JOHN B. WATSON, JOHNS HOPKINS UNIVERSITY (*J. of Exp. Psych.*)

JAMES R. ANGELL, UNIVERSITY OF CHICAGO (*Monographs*) AND

MADISON BENTLEY, UNIVERSITY OF ILLINOIS (*Index*)

WITH THE CO-OPERATION OF

J. W. BAIRD, CLARK UNIVERSITY; B. T. BALDWIN, UNIVERSITY OF IOWA; E. B. HOLT, HARVARD UNIVERSITY; W. S. HUNTER, UNIVERSITY OF KANSAS; J. H. LEUBA, BRYN MAWR COLLEGE; MAX MEYER, UNIVERSITY OF MISSOURI; R. M. OGDEN, CORNELL UNIVERSITY; W. D. SCOTT, NORTHWESTERN UNIVERSITY; E. E. SOUTHARD, BOSTON PSYCHOPATHIC HOSPITAL; F. M. URBAN, UNIVERSITY OF PENNSYLVANIA; G. M. WHIPPLE, UNIVERSITY OF ILLINOIS; R. S. WOODWORTH, COLUMBIA UNIVERSITY.

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*Report of the Secretary of the American Psychological Association:* H. S. LANGFELD, 25.

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# Psychological Review Publications

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WITH THE CO-OPERATION OF  
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# THE PSYCHOLOGICAL BULLETIN

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PROCEEDINGS OF THE TWENTY-SIXTH ANNUAL MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION, PITTSBURGH, DECEMBER 27, 28, 29, 1917

REPORT OF THE SECRETARY, H. S. LANGFELD, HARVARD UNIVERSITY

The twenty-sixth annual meeting of the American Psychological Association was held in affiliation with the American Association for the Advancement of Science at the Carnegie Institute of Technology on Thursday, Friday, and Saturday, December 27, 28, and 29, 1917. Owing to the activities of many of the members in war work, the program was shorter than usual, but the thirty-one papers offered sufficient material for a very profitable meeting. Four papers were of a general nature, nine were upon topics of experimental psychology, ten upon mental tests, five in educational psychology, two in abnormal psychology, and one upon the work of the Committee on the Classification of the Personnel in the Army. All but one of the sessions were held at the School of Applied Design of the Carnegie Institute.

The Thursday afternoon session and the business meeting following it were held in Psychology Hall of the University of Pittsburgh, and the members were given the opportunity at that time of inspecting the laboratories of that institution.

On Friday morning there was a joint session with Section H of the American Association for the Advancement of Science. Instead of having a parallel session on mental tests, the papers of this session were distributed throughout the other sessions. On Saturday morning there was a joint session with Section L of the American Association for the Advancement of Science. There was considerable discussion at this session, in marked contrast to the previous session, and the hope was expressed by many members that in

future meetings there would be an increase in the criticism and discussion. Considering the number of members who are in the service of the government and therefore could not be present, and the difficulties of transportation, the attendance was a large one. There were about a hundred members at the meeting, besides a number of visitors.

The apparatus exhibit was held in a room in the School of Applied Design near the lecture room and was an important feature of the meeting. Beside an exhibition by C. H. Stoelting Company of Chicago, there were the following new apparatus presented by members of the Association: A Pneumograph and A Short Exposure Apparatus, by C. T. Gray, University of Texas; A New Model Electro-Magnetic Stimulus Shuffler, and A New Control Machine for Continuous Choice Reactions, by L. T. Troland, Harvard University; A Seconds Pendulum and Interval Timer, by A. P. Weiss, Ohio State University; A New Acoumeter, A New Form of the Steadiness Tester, and Tactual Discrimination Cards, by Knight Dunlap, Johns Hopkins University; Models of Motion Studies, by F. S. Gilbreth, Providence, R. I.; Fifty Small Colored Pictures of Oriental Rugs for Esthetic Judgments, by K. Gordon, Carnegie Institute of Technology, a new form of the Self-Registering Tapping-Board by the Harvard Laboratory; a new form of the Pictorial Completion Test by W. Healy, Juvenile Court, Boston.

The annual dinner was held at the Pittsburgh Athletic Association. There were ninety present, including members and guests, and before the smoker the President, Major Yerkes, delivered an address upon Psychology in Relation to the War. He held the rapt attention of his audience for almost two hours in describing the historical development and work of the various psychological committees of the National Research Council.

The perfection in the arrangement of the various sessions was due to the untiring effort of Mr. J. B. Miner, the local member of the executive committee.

#### TRANSACTIONS AT THE ANNUAL BUSINESS MEETING

The annual business meeting was held at 4 p. m. on December 28 in Psychology Hall of the University of Pittsburgh. It was voted that the minutes of the previous meeting be accepted as printed.

The President then called for the reports of committees.

The secretary for Mr. Dodge, chairman of the Committee on

Election of Officers, reported the results of the ballot of the Association to be as follows: for President, Mr. John Wallace Baird, of Clark University; for members of the Council elected for three years in succession to Messrs. Angier and Scott, Messrs. Dearborn and Ogden. The report was accepted.

Mr. Yerkes reported that on account of the war the Committee on Standardization of Mental Measurements and Tests had made no progress. It was voted that this committee be continued.

Mr. Thorndike for the Committee on Teaching Experiments stated that there was no new work to report. It was voted that this committee be continued.

Mr. Baldwin reported that the war had also prevented any progress of the Committee on the Academic Status of Psychology. It was voted to continue this committee.

Mr. Warren reported the work accomplished by the Committee on Terminology and submitted mimeographed sheets and proof drafts of the results of its investigation. It was voted to accept the report, to continue the committee and to authorize the withdrawal of \$50 from the principal funds of the Association to defray the expenses of this committee for the following year.

The following items of business reported by the Council were then acted upon:

I. It was moved that the time and place of the next annual meeting be left to the Council with power. Mr. Buchner proposed an amendment that, if feasible, the meeting be conducted in conjunction with the American Association for the Advancement of Science. The motion as amended was carried.

II. It was voted to leave to the Council the appointment of a member of the council of the American Association for the Advancement of Science for 1918.

III. The secretary reported the deaths of the following members of the Association during the past year: Brother Chrysostom, January 23, 1917, aged 54; John Edward Russell, February 26, 1917, aged 70; Charles Hughes Johnston, September 4, 1917, aged 39.

IV. The Treasurer's report as printed below was read and accepted. The following budget prepared by the Council was also read and adopted.

## ESTIMATE OF RESOURCES

On deposit.....	\$ 67.00	
Dues.....	325.00	
Interest.....	90.00	
Sale of monographs.....	?	
Withdrawal from principal funds.....	400.00	\$882.00



## ESTIMATE OF EXPENDITURES

Printing and supplies.....	\$275.00	
Postage.....	125.00	
Reprints.....	75.00	
Abstracts.....	50.00	
Incidentals of meeting.....	25.00	
Apparatus exhibit.....	25.00	
Election committee.....	50.00	
Secretary's stipend.....	250.00	
Other committees.....	?	\$875.00

Mr. Buchner moved to authorize the secretary to withdraw the \$400 from the principal funds of the Association. The motion was carried.

V. It was voted to authorize the secretary to withdraw from the principal funds of the Association the sum of \$391.05 to defray the war expenses incurred by the President from April 10 to August 14, 1917.

VI. It was voted to reimburse the Council for their expenses incurred at the special council meeting in Philadelphia in April, and to authorize the secretary to withdraw the amount from the principal fund of the Association.

VII. It was moved that an amendment to the Constitution be made, increasing the annual dues from \$1 to \$2. Mr. Buchner moved that the motion be laid on the table. The motion was lost. Mr. Warren moved an amendment to increase the annual dues from \$1 to \$2.50. The amendment was lost. The original motion was then carried.

VIII. The secretary reported the following nominations to membership in the Association and was instructed to cast the ballot of the Association for their election: John E. Anderson, Ph.D., instructor in psychology, Yale University; William Howard Batson, Ph.D., head of the department of education and director of the training school, Southwestern State Normal, Weatherford, Oklahoma; Ethel Bowman, Ph.D., assistant professor of psychology, Goucher College, Baltimore, Md.; Clarence G. Bradford, Ph.D., professor of psychology, Ada, Oklahoma; Ivey Gertrude Campbell, Ph.D., associate professor of psychology, Wells College, Aurora, N. Y.; Helen Clark, Ph.D., instructor in psychology, Vassar College, Poughkeepsie, N. Y.; Harold Randolph Crosland, Ph.D., assistant professor of psychology, University of Arkansas, Fayetteville, Ark.; John Frederick Dashiell, Ph.D., instructor in psychology, Oberlin College, Oberlin, Ohio; Arthur Irving Gates, Ph.D., lecturer in

educational psychology, Teachers College, Columbia University, New York City; Buford Jennette Johnson, Ph.D., assistant psychologist, laboratory of social hygiene, Bedford Hills, New York; Edward Safford Jones, Ph.D., assistant professor of psychology, Oberlin College; Harry Dexter Kitson, Ph.D., instructor in psychology, University of Chicago; Frances Lowell, M.A., research assistant, department of research, State School for Feeble-Minded, Faribault, Minn.; Bertha M. Luckey, Ph.D., director of psychological research, Cleveland public schools, Cleveland, Ohio; David I. Macht, M.D., lecturer in pharmacology and instructor in clinical medicine, Johns Hopkins Medical School; William A. McCall, Ph.D., instructor in educational psychology, Teachers College, Columbia University; Donald G. Paterson, instructor in psychology, University of Kansas, Lawrence, Kansas; Louis Augustus Peckstein, Ph.D., assistant professor of psychology and education, University of Rochester, Rochester, N. Y.; Sidney L. Pressey, Ph.D., instructor in psychology, Indiana University, Bloomington, Ind.; Prentice Reeves, A.M., research psychologist, Eastman Kodak Company; Gilbert Joseph Rich, Ph.D., instructor in psychology, Hobart College, Geneva, N. Y.; Sarah Margaret Ritter, Ph.D., instructor in psychology, City Normal School, Sioux City, Iowa; Abraham A. Roback, Ph.D., instructor in psychology, University of Pittsburgh; Anna Sophie Rogers, Ph.D., demonstrator in biology, Bryn Mawr College, Penn.; Beardsley Ruml, Ph.D., instructor in psychology, Carnegie Institute of Technology; George Samuel Snoddy, Ph.D., assistant professor of psychology, University of Utah, Salt Lake City; Aaron Moyer Snyder, Ph.D., assistant professor of psychology, University of Pittsburgh; Percy Ford Swindle, Ph.D., instructor in physiology, Tufts College Medical School, Boston; Robert Brown Teachout, Ph.D., assistant professor of psychology, University of Oregon, Eugene, Oregon; Lewis M. Terman, Ph.D., professor of education, Stanford University; Louis L. Thurstone, Ph.D., instructor in psychology, Carnegie Institute of Technology; Louis Winfield Webb, Ph.D., instructor in educational psychology, Northwestern University, Evanston, Ill.; Raymond Holder Wheeler, Ph.D., assistant professor of psychology, University of Oregon; Jesse Hayes White, Ph.D., professor of psychology, University of Pittsburgh.

IX. The membership of the program committee for the ensuing year was announced as follows: Messrs. Angier, Baird, and the secretary.

X. Mr. Hollingworth as a committee of one appointed by the President on the recommendation of the Council offered the following resolution: "That the American Psychological Association, at its annual meeting, held at Pittsburgh, December 27-29, 1917, hereby expresses its approval of the aims and purposes of Senate Bill 2403, now pending, relating to the provision for establishment and maintenance of model demonstration rural schools; and of House Bill 6490, now pending, relating to the promotion of plans for the elimination of adult illiteracy in the United States; and that the secretary of the Association be requested to forward copies of this resolution to the proper representative in each House of Congress; to the chairman of the Education Committee of the House of Representatives; and to the Senate Committee on Education and Labor." The resolution was adopted.

XI. It was moved and carried that a committee be appointed by the president to report at the next annual meeting concerning the qualifications for psychological examiners and other psychological experts.

XII. It was moved to authorize the president to appoint a permanent committee on publications of applied psychology whose duty shall be to survey the publications, to approve such as seem to them worthy of publication; to condemn those which seem unfit, and to authorize the said committee to publish their report in *Science*, *THE PSYCHOLOGICAL BULLETIN*, and in such other publications as they may select. There was a lengthy discussion in which Messrs. Buchner, Warren, Kelly, Baird, Rogers, and Strong took part. Mr. Wallin offered an amendment to the effect that the function of the committee should be to pass upon material absolutely clap-trap. The amendment was lost. Mr. Aiken moved an amendment to substitute for that part of the original motion which read "whose duty shall be to survey, etc." the following: "whose duty shall be to consider the general merits of publications in, or professing to be in the field of applied psychology, and to publish their findings." The motion was carried as amended.

Under the head of new business Mr. Odgen moved, that the American Psychological Association express by a rising vote to its hosts of the Carnegie Institute of Technology and of the University of Pittsburgh, its deep appreciation of the excellent arrangements made for this meeting, and its hearty thanks for all the favors and courtesies being shown to its members. The response was unanimous. The meeting then adjourned.



## REPORT OF THE TREASURER FOR THE YEAR 1917

Dr.		
To Balance from the previous year.....	\$2,654.46	
Dues received from members.....	330.35	
Interest from July 1, 1916 to July 1, 1917.....	90.17	
Gift from member.....	30.00	
Sale of monographs No. 51 and No. 53, year ending December 31, 1916.....	23.82	\$3,128.80

Cr.		
By Printing and supplies.....	\$ 172.98	
Postage.....	71.85	
Express.....	1.72	
Telegrams.....	1.44	
Reprints of Proceedings.....	31.06	
Reprints of President's address.....	20.43	
Incidental expenses, 1916 meeting.....	50.00	
Printing of Abstracts, 1916 meeting.....	24.72	
Expenses Election committee, 1917.....	29.02	
Secretary's stipend.....	250.00	
Exchange on checks.....	.10	
Committee on Terminology.....	30.00	
Committee on Teaching Experiments.....	5.56	
Committee on the Academic Status of Psychology.....	70.00	
Binding two volumes of the Proceedings.....	3.00	\$761.88
Balance in Fifth Avenue Bank.....	67.98	
Balance in Union Dime Savings Bank.....	2,298.94	2,366.92
		\$3,128.80

H. S. LANGFFLD,

*Treasurer*

Audited by the Council

CAMBRIDGE, MASSACHUSETTS,  
December 22, 1917

## TITLES AND ABSTRACTS OF PAPERS

### PRESIDENTIAL ADDRESS

*Psychology in Relation to the War.* ROBERT MEARNES YERKES,  
University of Minnesota.

### GENERAL AND EXPERIMENTAL PSYCHOLOGY

*The "Mnemometric Function" and the Memory-Methods.* E. G.  
BORING, Cornell University.

The similarity of the problems of the "measurement of sensation" and of the "measurement of memory" suggests that we may determine a "mnemometric function," comparable to the psychometric function, and find a measure of memory in an associative limen. The required "mnemometric function" can be found by the application of some method of partial mastery (right associates, retained members, promptings, *etc.*) and shows percentages of material learned as a function of some effective condition of association, *e. g.*, number of repetitions or number of syllables in a series.

We may expect this "mnemometric function" to be approximated by the *phi*-function of *gamma* (*a*) because it is analogous to the psychometric function for sensation, (*b*) because it is indicated by certain properties of the nervous system, and (*c*) because it is actually thus approximated in experimental results, when we assume that successive repetitions are progressively less effective for learning.

The determination of associative limens from "mnemometric functions" renders a comparison of results taken under various conditions (as well as a comparison of different methods of partial mastery) easy and accurate, since we have for comparison single values of known precision.

The probable form of the "mnemometric function" indicates that methods of complete mastery are, of all memory-methods, least reliable; that half-mastery is approximately the most reliable measure of memory; and that various percentile differences in methods of partial mastery are not usually comparable.

The determination of the "mnemometric function" depends

upon a knowledge of some effective condition of association, *e. g.*, the relative value of successive repetitions for learning. The solution of this latter problem, conversely, depends absolutely on the solution of the former. Hence a joint solution is necessary. Experimental data, obtained by Mr. H. D. Williams, show that the compound assumption that associative impression is proportional to the logarithm of the number of repetitions and that the "mnemonic function" is the *phi*-function of *gamma*, is a fairly accurate hypothesis. The problem of the associative value of different lengths of series must be solved in the same manner.

*The Effect of Distraction upon Reaction.* E. E. CASSEL and K. M. DALLENBACH.

The aim of the experiment was twofold: first, to discover the effect of distraction upon the simple sensory reaction; and secondly, to discover the cause of the differences in results previously obtained.

The Hipp chronoscope and its accessories were employed, and the usual method of reaction experiments was followed. Reaction was made to the sound of a Wundt hammer.

After three months of training, for the attainment of a high and steady level of practice, the distraction-series were undertaken. Three distractors, a metronome, a bell, and a tuning fork, were used in different temporal relations. The bell rang for 2.5 seconds, beginning 1 second before the reaction stimulus. The metronome beat during a series of ten reactions, but was silent during the subsequent report. The tuning fork sounded continuously during the writing of the reports as well as during the reactions. In every hour from 8 to 10 series were taken, two to four of which were normal, serving as a control. These occurred equally often in the 1, 2, 3, 4, etc., place. 100 series with distraction, and 20 to 40 series of control reactions, were obtained for every observer with every distractor.

The gross averages of the distraction and control series showed that the distractors were always effective in the direction of a lengthened reaction; that the bell, the intermittent distractor, was the most effective; and that the tuning fork, the continuous distractor, was the least effective. The daily averages were, however, equivocal. On some days the distractors seemed to inhibit, on other days to facilitate reaction. The introspective reports showed that these variations were closely paralleled by changes of attitude. Hence we may conclude that the effect of distraction is dependent upon the observer's attitude.

This analysis explains the apparent contradiction in our results; the neglect of the factor of attitude by other investigators explains the equivocal nature of the results upon the effect of distraction so far published.

*Vasomotion as a Test of Will Power.* G. V. N. DEARBORN, Sargent Normal School, Cambridge.

Through a comparative study of the brachial vasomotion of the series of idiots, imbeciles, morons, terminal dementes, people "unable to concentrate," average persons, persons of unusual will-power, etc., the proposition that peripheral vasomotion is a criterion of will-power was suggested, and then proven to be true. The writer's "continuous" blood-pressure method was employed. The numerous hemobarograms of the research (as well as the protocols) are exhibited as part of the paper.

Certain tests of mental concentration in various directions were given to the subjects and the varying concomitant arterial tensions measured. These members in variation were then interpreted in the light of collateral evidence as to the mental dynamism of the respective subjects.

It is suggested that this test, wholly new in nature as well as in technique, is one of practical use in psychological examining.

*Incentive and the Curve of Mental Work.* F. C. DOCKERAY, University of Kansas.

When a subject is instructed to work at his maximum both as regards speed and accuracy, there is a tendency to make adjustments according to the length of period. The result is that little or no fatigue is evidenced in mental work at the end of one or two hours. Ergographic studies in which the subject is to work for a definite period show somewhat similar results. In adding figures both speed and accuracy vary. In the present investigation speed was controlled and only accuracy could vary in the record. The subjects added series of ten digits, dictated at a regular rate, in fifty to ninety minutes. A definite period was allowed after each series for the subject's response. The results uniformly showed a decided decrease in accuracy beginning with the second or third ten-minute period in untrained subjects, and with the end of the first ten-minute period as the subject gained experience with the test. The score of the last ten-minute period in a ninety-minute record often went as low as fifteen per cent. of the first ten-minute

period. When the subjects set their own "maximum" rate no such decreases were noted, and there were some individual differences in the curve not noted in the former case. There was not a definite correlation between speed and accuracy on different days, though in any one period there was a strong tendency to an increase in errors with a decrease in speed.

*A Study of Esthetic Judgment.* K. GORDON, Carnegie Institute of Technology.

Fifty colored pictures of oriental rugs were used as material to be judged. These were divided into two sets of twenty-five each; and subjects were asked to arrange in order of beauty the twenty-five of series one, and then to do the same for series two. One hundred and one persons took part in the test, and a distribution curve of their choices was made for each rug. The correlations between the judgments of each individual and the average of these correlations is .42 for the first series, and .42 for the second. In no case was a significant negative correlation found. The correlation between the average arrangement of the first half of the judges and the second half of the judges is .82 for one series of rugs and .87 for the other. The correlation between the average arrangement of thirty men and thirty women is .86 for each series of rugs.

*The Logic of Intermediate Steps.* H. L. HOLLINGWORTH, Columbia University.

A familiar form of argument in the natural sciences, especially in biology, psychology and anthropology, is based upon the evidence afforded by the existence of intermediate stages between two conditions, types or processes whose nature or origin is in question. The existence of such intermediaries is commonly held to indicate that the two extremes are either identical in essence or structure, or at least that the one is a direct development of or evolution from the other. The final abandonment of this serial argument in biology is pointed out. Numerous instances will be given from psychological discussions, in which this argument on the basis of intermediaries is still relied on. Specific references will be to Clarke, Kropotkin, Exner, Helmholtz, Watt, Brentano, Stout and Titchener. Objections to the validity of the argument will be cited from Miller, Bergson, McDougall, Bateson, Meumann and Woodworth. The argument involves a common type of logical fallacy, that of "affirming the consequent." The inadequacy and fallacious



character of this argument has already disqualified it in biology, history and anthropology, and should also be recognized in the interpretations of human institutions and individual experience. "From the fact that we pass from one thing to another by degrees, it does not follow that the two things are of the same nature."

*Kinæsthetic Sensory Processes in the White Rat.* W. S. HUNTER, University of Kansas.

The present work makes chief use of the T-shaped discrimination box of my earlier work on auditory sensitivity. The method was to force the animal to turn to the right in one trial and be fed, and then to turn to the left in the next trial and be fed, etc. Or he might be trained to alternate by twos (llrllrll), being fed after each trial.

Seven rats tested on lrlrlr, 10 trials daily, learned the rhythm in from 10 to 180 trials,—where the criterion of learning was an average of 87.5 per cent. correct for four days and no day below 80 per cent. The interval between trials was 12 secs. There was practically no habit interference when the opposite order of presentation was used (rlrlrl).

Five rats were now tested on a double alternation (llrllrll), 10 and 12 trials daily for 600 trials without improvement in the reaction. The interval between trials was 12 secs. Five rats were trained on double alternation, 8 trials daily with no feeding or time interval between trials. Learning was not apparent after 500 trials.

A maze was constructed of 10 T-shaped boxes so arranged that the choices were llrllrll. One trial a day was given each of six rats. All learned it readily. They were then transferred to the above problem of double alternation in the single T-shaped box. The alley stops were shifted while the animal was running so that a continuous path in the form of a figure 8 was always before him. His problem was to run twice around one loop and then twice around the other until 10 runs had been made. This problem, which may be termed a temporal maze, was never learned. Such a temporal maze composed of turns lrlrlrlr was mastered by one rat. Controls were used which indicated that contact cues derived from the end-stops were necessary cues in all cases of the temporal maze.

Kinæsthetic processes occur in time and not in space save as they are accompanied by vision or touch. If the white rat were

chiefly dependent upon a mere succession of kinæsthetic processes in running a spatial (the ordinary) maze, he should succeed in a temporal one. This he can do only when the latter is very simple.

Interesting comparative data have been secured with humans on a similar pencil maze.

*Facial Expression and Suggestibility.* H. S. LANGFELD, Harvard University.

The aim of the investigation was threefold: to ascertain the degree of accuracy in judging facial expression, to determine the suggestibility of subjects in the interpretation of facial expression, and to devise tests both for skill in judging character from faces, and for suggestibility in this field.

The stimuli used were one hundred and five pictures selected from the atlas accompanying the book of Heinrich Rudolph entitled *Der Ausdruck der Gemütsbewegungen des Menschen*. They are sketches of faces of a talented artist expressing various emotions and attitudes. Extensive preliminary experiments were made upon six subjects to determine the best methods of approach, the value of the various pictures for the purpose, and the possibility of agreement among the subjects.

The pictures were then presented (by Miss G. Speir) to five new subjects for their judgment as to the expression. Either the correct title, or one differing radically from it was then presented. Each picture was presented twice in the semester, once succeeded by the correct title, and once by the incorrect title.

It was found that all subjects accepted at times the incorrect title even when they themselves had approximated and accepted the correct title of a picture which had been proven to be a good portrayal of the expression in question. When the subject had not approximated the correct title, the suggestibility was naturally greater. The accuracy of suggestibility varied considerably with the emotions expressed, and with the subjects. One subject who apparently had little visual imagery, was extremely inaccurate and highly suggestible.

From the data, it was possible to select a series of pictures to be used in the development of tests.

*The Attributes of Sound.* R. M. OGDEN, Cornell University.

Pitch is the predominance in a sound which varies from low to high. The discrimination of this attribute at the middle range of

audibility correlates with an arithmetical progression of vibrational frequencies. Volume is the massive effect of sound, and grows progressively less from low to high. Its discrimination is correlated with a geometrical progression of vibrational frequencies. The pitch of a pure tone is central to its volumic pattern, and represents a salient in the intensity of the total mass. Intensity is gauged by the rise of the pitch salient together with the total mass. Duration is the orderly progression or protensity of the sound in time. Brightness is the emergence of the pitch salient from its volumic mass. It is dependent upon the pointedness of the pitch salient, but not necessarily upon the intensity of the sound. Low tones are usually mellow or dull; they are also diffuse or voluminous. High tones are usually shrill or bright; they are also small, piercing, deficient in volume.

There are three kinds of sound: tones, vowels and noises, having the characteristics, respectively, of tonality, vocality and noisiness.

Tonality embraces fusion and the relatedness of intervals. Musical interval is based upon volume distance, but there are special functions that regulate combinations with respect to all the attributes. Fusion rests upon coincidence of volumes and relational effects of the pitch salients made possible by certain functions of the ear and brain. The interdependence of pitch and volume is indicated by the atonal character of very high and very low sounds of regular vibrational frequency. In the former case volumic differences are too small, and in the latter case the pitch salients are too slight, to permit fusion or define intervals.

Vocality is a characteristic of sounds having regional pitch, but no salients. Volume differences by halves, corresponding to the octave interval, seem to govern the order of the chief vowels.

Noisiness is a characteristic of sounds in which the salient pitches are confused or irregular.

*Analogies Between Behavior and Complex Mental Processes.* W. B. PILLSBURY, University of Michigan.

Animal and human learning has been analyzed into two distinct processes: hitting upon a successful response, and accepting it as successful. All appreciate that this offers two problems, one regarding the origin of the successful responses, the other regarding the nature of the acceptance of one as successful.

The same distinction may with profit be made of what are regarded as the more complex mental operations. I long ago

suggested that conclusions in reasoning were attained by a process of trial and error. We can extend the notion to formation of concepts and percepts, as well as to the memory processes, where it was first noticed. Recall is usually a tentative operation, with many suggestions offered by association, and recognition as the stamp of success. Concepts arise in the course of thought after many conjectures and the rejection of many proposals. A case may be made for the development of percepts by the same method.

If this analogy holds we must carefully distinguish two problems often confused, the one of the origin of the suggestions: habit, instinct, association, etc., the other of the means of testing: pleasure or satisfaction, recognition, belief, or what not, that may be pictured as the name for selection.

*An Experimental Study of Adolescence.* C. RAHN, University of Illinois.

One of the purposes of this study was to discover whether in the case of normal adolescent males any relation exists between mental and physical functions on the one hand, and sexual rhythm on the other. Throughout a period of ninety days a free-association-test, a multiplication-test, and a dynamometer-test were given daily; and a record taken of dreams, of prevailing moods, and of organic conditions. The results reveal certain typical changes (1) in the curve of energy-output, (2) in affective coloring, (3) in alimentary functions, (4) in intellectual efficiency, and (5) in associational processes—as correlates of different phases of a periodic organically determined sexual "set" or tendency. It is the relation of associational tendencies to the periodic factor that we wish to report upon here. This relation is revealed in the free-association-tests and in the dream-records. In the association-tests 20 stimulus-words were given daily. The first ten were chosen entirely from the list of Woodworth and Wells. The results from these first ten words were used to obtain the daily average of reaction-times. These reveal no striking variations that might be attributed to the periodic function. Scattered throughout the second ten words of the daily list were three "critical" stimulus-words. Two of these were regularly taken from some dream-account of the subjects. The third was always one that is in common use to convey non-sexual meanings, but is at the same time the possible carrier of another meaning that is sexual in character. Here the results indicate a correlation between the organic periodic

factor and modifications in the response to certain specific stimulus-words, both with respect to manner of reaction, and with respect to meaning. Another indicator of a relation between an organic sexual rhythm and changes in associational processes is to be found in the temporal distribution of the erotic dream. This distribution indicates that the periodic organic set involves, among other things, a lowering of the threshold for those associative connections which, upon becoming active, give to the dream, under the influence of this particular set, an erotic coloring. We would not deny the significance of the environmental factor as a determinant of the dream-content; but we would point out that the organic factor takes its place alongside of the environmental. In fine, we have found that much that has been attributed to mythical psychical "complexes" can be definitely referred to specific organic conditions.

*Rate of Pupillary Dilation and Contraction.* P. REEVES, Research Laboratory of the Eastman Kodak Company.

In the first part of this experiment instantaneous flashlight photographs were taken of the pupils of two subjects for eight brightness levels, including total darkness at one end and the just tolerable reflection of full sunlight from white paper at the other end. The effect of exposing one or both eyes to the sensitizing field was determined for both subjects throughout the brightness range.

From these curves six brightness levels were chosen and the pupils of six subjects were measured, one of the first subjects being used in this series to check the method. In this part of the experiment a motion-picture camera was used and a lamp bank displaced the flashpowder.

The rate of closing of the pupil was measured by taking motion pictures of an eye fully adapted to darkness, hence maximum diameter, as it closed to a diameter almost its minimum. The same six subjects served as well as two others and the average pupil closed in less than five seconds. The greater part of the contraction occurs within the first two seconds.

The rate of opening was determined for seven subjects, the above six and one other, as the pupil opened from near a minimum to a maximum diameter. The average pupil required from three to ten minutes to reach its maximum diameter.

The plotted curves of these results are similar in shape though marked individual differences are shown as well as variations in the results from the same subject on different days.



*Interference of Will-Impulses.* A. A. ROBACK, University of Pittsburgh.

The purpose of this investigation was to find out what happens when there is a rapid alternation of two sets of will-impulses, and in what way they affect one another. The problem was divided into two parts: (a) Simple finger movements recorded on a kymograph in response to visual stimuli; (b) writing impulses recorded on rolls of paper to the dictation of words, numbers, geometrical figures and other symbols.

In the simple movement experiments, the variations comprise comparisons between (a) lateral and downward reactions of forefinger; (b) downward reactions of forefinger and middle finger; (c) downward reactions of middle finger and ring finger; (d) flexor and extensor reactions of forefinger; (e) spontaneous and controlled reactions. The left hand was used for all experiments. Every one of the thirteen subjects who took part in the simple movement experiments emphasized the easier reaction at the expense of the more difficult one. Thus, the downward reaction was favored in comparison with the lateral; the forefinger reaction was objectively preferred to the middle-finger reaction. Likewise the middle finger was favored as compared with the ring finger; and the flexor movement of the forefinger was far in advance of the extensor movement in the number of reactions.

The objective results showed that there was a universal tendency to take the course of least exertion, calling into play the following phenomena: (a) a leveling process; (b) rhythmic activity; (c) grouping of mistakes; (d) random reactions. The most important conclusion in regard to the introspective results is the retroactive inhibition of determining tendencies, the most specific being the first to be disturbed and the last to be reinstated; while with the most general determining tendency the reverse is true.

The handwriting experiments gave evidence of many phenomena such as automatism, graphic stammering, slurring of vowels; and furnished us with an extensive scheme of graphic inhibition. But, the most significant result here is the fundamental difference between the sensory and the motor phase of inhibition. Sensory inhibition is characterized by dissimilation; motor inhibition by assimilation, assimilation to be understood in the sense that one element tends to resemble another. The Ranschburg inhibition, in spite of the generally accepted view, does not hold on the motor side. Our results, because of the material used,

tend to disprove the Freudian theory of speech and writing lapses, or at least to confine its validity to a very restricted range.

*Some Experiments in the Transfer of Habits in the White Rat.* H. A. RUGER, Teachers College, Columbia University.

The first part of the experiments was concerned with an attempt to determine the effect of preliminary semi-circular canal practice on the subsequent ability of the rat to learn the Hampton Court maze. A series of rats were carried in a closed car several times around the correct path of the Hampton Court maze. They were then tested by being placed in the maze under the usual conditions and their learning reactions were recorded. A control series was employed in which no such preliminary training was used. In general the results were negative in so far as evidence of effect of the semi-circular canal practice was concerned.

In the second part of the experiment the effect of certain variations of conditions were studied such as the following: (1) The last half of the maze was learned, the blind alleys being closed; the blind alleys were then opened and the effect on the habits set up was studied; (2) the last half of the maze was learned first, and then the animals were allowed to run the whole maze and the character of the reactions in the last half was recorded; (3) the maze was rotated 90 degrees and 180 degrees; (4) the maze was lined with black paper to disguise certain of its features. In most of these four cases there was some disturbance of the old habits when the new conditions were introduced, but the effect was relatively slight and the old habit soon asserted itself.

*The Work of the Committee on Classification of Personnel in the Army.* W. D. SCOTT, Carnegie Institute of Technology.

This committee was formally authorized by the Secretary of War on August 3, 1917, and empowered to put into actual practice in the Army, certain methods which have already been found useful for classifying men, and also to experiment in an attempt to devise new methods for classifying men in a way helpful to the Army.

This committee has coöperated with all of the agencies of the Army which have to do with promoting or selecting men and of assigning them to that sphere in the Army in which they may be of the greatest use.

*On the Genesis of Ideas of Inferior Spirits.* W. T. SHEPHERD, Washington, D. C.

The paper presents the results of a psychological examination of typical ideas of spirits as held by different peoples, ancient and modern. The writer attempts inductions as to the mental factors involved in the conception of spirit ideas. He believes that such an examination warrants the following as at least partial explanation of the question of spirit ideas: (1) The imagination has been a most important factor in the genesis of such ideas; (2) credulity has been a factor; (3) fear has in some cases been concerned in the genesis, *i. e.*, in impelling to such conceptions; (4) reverence and love for dead friends have, in some instances been concerned; (5) natural phenomena have played a part; (6) the phenomena of sleep and dreams may have been concerned.

*Psychological Wants of Psychiatrists; a Psychopathic Hospital Point of View.* E. E. SOUTHARD, Psychopathic Hospital, Boston.

Discussion of wants might lead to a definition of needs. The psychiatrist approaching psychology has some initial lacks largely due to the peculiar individualism of physicians.

The reader will attempt to enumerate the special ways in which psychiatric diagnosis and psychiatric theory at the Psychopathic Hospital would be benefited by new tests and new points of view on the part of the psychologist.

*The Forgetting Curve as Affected by Conditions of Learning.* E. C. TOLMAN, Northwestern University.

It was shown by the author in a recent investigation that work undertaken immediately after the learning period causes relatively more retroactive inhibition for lists of nonsense syllables learned in an inefficient working period than for lists of nonsense syllables learned in an efficient working period of the day.

The present experiments attempt to discover if there may not be in addition some consistent difference between the forgetting curves for materials learned under the two conditions. Our results, in the first place, seem to indicate that the initial drop in the curve is greater for the material learned in the inefficient working period than for that learned in the efficient working period; secondly, they present some evidence that retention after twenty-four hours is nevertheless nearly or quite as great for the material learned in the inefficient working period as for that learned in the efficient working period.

We conclude that there must be some fundamental difference between the nature of the learning impressions made under the

two conditions which will explain not only this difference between the forgetting curves but also the greater retroactive inhibition earlier found for the inefficient condition.

*A Synaptic Theory of Affective Intensity.* L. T. TROLAND, Harvard University.

The nervous system can be regarded as a complex network of conductors, every portion of which is connected with every other portion. If this network is treated by analogy with a system of electrical conductors, the distribution of excitation over it at any time should be determined by (1) the distribution of exciting forces and (2) that of internal conductivities. The former corresponds with the stimulus pattern, the latter with the pattern of synaptic conductivities at the various levels of afferent-to-efferent transfer. Assuming an hereditary *tabula rasa*, the conductivity of any synapse at any time should be equal to the time integral of the rate of change of its conductivity throughout the individual biography.

According to classical psycho-physical theory, the introspective consciousness is directly dependent solely upon some part of the cerebral synaptic excitation, in the highest and most comprehensive region of neural adjustment. The proposed theory postulates that the introspectable affective intensity—the degree of conscious pleasantness-unpleasantness, treated as an algebraic variable—is at every instant proportional to the sum of the rates of change of conductivity in these cortical synapses. It follows from this postulate that, on the cortical level of transfer, the pattern of synaptic conductivities at any time should be determined by the time integral of the affective intensity, experienced by the individual up to that time, in connection with each cortical synapse.

Alteration in synaptic conductivity may be ascribed to three main influences: (1) increases due to the direct action of stimulus forces, (2) increases due to the action of stimulus forces *via* hereditary mechanisms of facilitation and (3) decreases due to the action of stimulus forces *via* hereditary mechanisms of inhibition. The theory of these influences involves a discussion of habituation and instinct.

The correspondence of the consequences of the general theory with the facts is considered.

*Sound to Light: Conditioned Reflex.* A. P. WEISS, Ohio State University.

The aim of the experiment is to investigate intensively a typical human conditioned reflex with a view toward determining the neural conditions when a choice reaction is made between two simultaneous stimuli, but to only one of which the reagent is instructed to respond.

The experimental conditions are as follows: The reagent reacts to a telephone buzz by depressing a key. He is to react only to the sound. He is to keep his reaction-time within a certain limit. When he is reacting too slowly a red light flashes before him, urging him to "speed up." The sound is given irregularly at an average rate of about one per second. With each sound a visual stimulus (electric light) is also presented, but in fifteen per cent. of the reactions the light is given without the sound. The number of times the reagent gets "caught" (by the light) measures the extent to which the visual stimulus has been substituted for the auditory stimulus. Each sound-light complication series is followed by a sound-only series which is used as a control.

The factors studied in the substitution of the light for the sound stimulus are: (1) The "internal" factor or those instances in which the reagent reacts "spontaneously" when neither sound nor light are present. (2) The influence of the "speeding up" process. (3) The influence of the intensity of the substitution light.

#### EDUCATIONAL PSYCHOLOGY

##### *Objective Measurement of Relative Size of Units in a Judgment Scale.*

S. A. COURTIS, Detroit Public Schools.

Twenty-eight quadrilaterals were submitted to a group of adults and arranged by them in order of size on basis of visual judgment only. From the resulting data the relative sizes of the figures were computed in terms of the smallest sample, making use of the "equal difference" theorem. The zero point of the series was then estimated and appropriate samples selected to form a scale for area. The area of the same figures in square inches was then determined by means of a planimeter and the relative sizes of the units in the judgment scale compared on an objective basis. The data were too few to yield conclusive results, but tend to show that unit differences in area (differences noticed by 75 per cent. of the judges) were greater for large areas than for small.

##### *A Comparison of Two Types of Learning by Means of a Substitution Test.* C. T. GRAY, University of Texas.



It is the purpose of this paper to report the results of an investigation in which two types of learning have been compared. Such a comparison is made from four different standpoints: (1) by means of learning curves, (2) by a compilation of errors, (3) by means of retention tests, and (4) by means of transfer tests.

The material which was used is in the form of a substitution test. Each letter in the alphabet is replaced by a number combination. The material to be translated into the code is placed on the left of the page. In transcribing this material the problem of the learner is to transfer the digits in the number combinations into short horizontal lines. Another important feature of the test is that the number combinations are made up according to a definite system, which shows itself readily when the letters are arranged in their alphabetical order.

The test had been given in two different ways, which may be spoken of as Method I. and Method II. Those who worked according to Method I. had the printed sheet, with the alphabet and the number combinations before them at all times. In the second method, the alphabet was torn from the sheets. Those who worked according to this plan had the organization of the code explained to them.

The curves procured from the two types of learning show that Method II. makes for a wider distribution of ability than does Method I. The curves for those who show great proficiency by each method differ also in their form. Such curves for Method II. begin lower than those for Method I. and remain so for some time.

A number of the records made in the substitution test were checked for errors. The general conclusion to be reached here is that in the earlier periods of training there are more errors in Method II. than in Method I., while in the latter part of the experiment there is very little difference in the number of errors made in the two methods.

Tests were also made upon transfer and retention according to these two methods.

*Determinants of Error in Spelling.* L. S. HOLLINGWORTH, Teachers College, Columbia University.

The present report is a fragment of a somewhat extensive research in the psychology of special disability in spelling. In the course of this research, a study was made of the factors which work either intermittently or constantly to cause error, and of those

which tend to limit its extent. Two points are presented at this time in detail: (1) Knowledge of Meaning as a Determinant of Error, and (2) Factors Limiting the Extent of Error.

(1) Knowledge of Meaning as a Determinant of Error. Thirty words were pronounced to the children who were the subjects of the research, with instructions to spell each word, and to give its meaning by writing a sentence containing it. The result showed that the children misspelled their misused words much more frequently than they spelled them correctly; and that they misused their misspelled words much more frequently than they used them correctly. In order to establish the reliability of the result a second list of words was given in the same way, with the same outcome. The conclusion is that knowledge of meaning is in and of itself an important determinant of error in spelling.

(2) Factors Limiting the Extent of Error. It was demonstrated that the average deviation from the correct number of letters among misspelled words is very small; that there is a constant tendency for misspellings to be slightly too short; that misspellings are composed more often than not exclusively of letters included in the correct spellings; that the percentage of error varies greatly with the position of a given letter in the word, the initial letter being almost always right, and the first half of the word having a great advantage over the last half; that incorrigibly poor spellers show the same tendencies in these particulars as are shown by the rest of the group, excluding them.

*The Spelling Ability and Vocabularies of 200 College Students.*  
E. MURRAY, Wilson College.

Each student of the freshman, sophomore, junior, and senior classes was asked to estimate her spelling ability as good, poor, or medium. She was then subjected to a written spelling test based upon a list of 20 non-technical words, selected from the average vocabulary of college written work. Rank in this test was then correlated with the self-estimates, and with rank in freshman English. Cases of low spelling ability were made the subject of special investigation.

Each student was further asked to estimate her reading vocabulary as extensive, limited, or average. The Terman and Childs Vocabulary was then presented as a group test, with directions to calculate the number of words known out of the hundred. Definitions of the last twelve known words in the list were then called for.

The resulting scores were then correlated with rank in freshman English, and in spelling, and with self-estimates.

In the case of the senior and junior classes, correlations were also calculated between the scores in these two tests and class-estimates (by the method of relative position) of general mental ability; and with scores in cancellation tests.

*"Part" vs. "whole" Methods in Learning Nonsense Material.* L. A. PECHSTEIN, University of Rochester.

It has been shown that certain modified forms of the "part" method are more efficient for mastering a complex motor problem than the "whole" method. In this paper are presented the results obtained from the several novel methods when nonsense series are being learned. The method of "paired associates" is utilized. Comparative results are offered for the following methods: (a) "whole" method; (b) pure part method; (c) direct repetitive method; (d) reversed repetitive method; (e) progressive part method. University students are used for subjects.

*Elements in Reading Ability.* D. STARCH, University of Wisconsin.

The paper reports a series of experiments designed to ascertain the importance of various factors in reading ability, such as span of visual attention, rapidity of eye-movements, rapidity of association, and control of speech functions.

#### MENTAL TESTS

*A Study of Apperceptive Abilities.* A. L. BRONNER, Juvenile Court, Boston.

Definition by different psychologists of the term apperception shows divergence both of meaning and significance. Limiting the term to the most widely accepted usage we may evaluate certain mental tests largely involving apperception to find correlations between these tests themselves and between them and tests for other mental processes. We may also note individual differences in apperceptive ability and the extent to which some individuals show variations in different fields, for example in their performance of tests dealing with concrete material as compared with those involving language. The findings in a group of delinquents are of special interest, particularly in so far as they have a bearing on the interesting question of the relation of apperception to conduct careers.

*The Stanford Revision as Applied to College Students.* H. H. CALDWELL, University of Wisconsin.

The Stanford Revision tests for adults were given to fifty students of the Randolph-Macon Woman's College, half of whom were sophomores and half juniors. In addition to these a small group of seniors were tested. The writer had first-hand acquaintance with the work of every girl examined, through either class room or laboratory; and to guard against any influence which personal opinion might exert upon interpretation and grading, the tests were given by six seniors of the class in Mental Tests, who had been thoroughly trained in the technique.

The ranking of the students in the tests is compared first with their general intelligence as estimated by several members of the faculty and student body, and second with their average grades since entering college. Sophomores are compared with juniors as to average intelligence quotient, and correlations between this and estimated intelligence and grades. Examination is then made of the tests which were most often failed in, by students having a high intelligence quotient and by those whose intelligence quotient was average. Two main facts seem evident from this examination. The first is that alternate 2, in the Average Adult Test, which calls for "comprehension of physical relations" is not adapted to women and girls. To the half dozen men examined by the writer, with intelligence quotients varying from 92 to 118, it seemed to present no difficulties. The second conclusion is that in the Superior Adult Test, too much stress is laid upon immediate memory. There are six tests, two of which are of this character. Several exceptionally good students, whose general intelligence was estimated to be high, had intelligence quotients indicating only average intelligence because of failure to pass these two tests and number 5 of the Average Adult Group, which is similar. Alternate test I of the Average Adult Group proved a stumbling block for these same persons. These failures all showed a poor auditory memory span. It would seem that at least one of these tests might be replaced by one not involving auditory memory.

On the whole, the tests correlate well with both estimated intelligence and college grades, and may therefore be taken as a fairly good method for determining the intelligence of adults. The writer considers it the best method yet available, but believes that it will ultimately be superseded by the use of special tests for special abilities.

*The Frequency of Deficiency among Delinquents.* J. B. MINER,  
Carnegie Institute of Technology.

The results of some score of studies, embracing Binet examinations of over seven thousand delinquents, were reinterpreted on a common basis. The proportions testing presumably intellectually deficient and doubtful were indicated in a table. These borderlines corresponded roughly to the lowest 0.5 per cent. and the next 1.0 per cent. of the general population. Comparison was made between groups in state prisons, reformatories, county and city institutions. In general the least deficiency is probably to be found among delinquents from the juvenile courts, contrary to a common opinion. The most deficiency is found among the reformatory groups of women and repeaters in local jails and workhouses. Estimates of deficiency among delinquents should be compared for the type of institutional group considered.

*The Learning Curves of the Analogies, Mirror Reading and Alphabet Tests.* F. A. C. PERRIN, University of Texas.

The investigations reported in this paper deal with the learning curves of three mental tests. For each of the tests employed, new material was given the subject at each trial or sitting; the curves therefore represent the progressive ability to react to new content in the light of experience with similar content, rather than the ability to improve in repeating identical material. The analogies test was chosen because of its seemingly high correlation with intelligence; the mirror reading test was selected because it promised to show a relatively pronounced amount of improvement. The alphabet test seemed to be intermediary between the two. Ten different lists of 25 analogies each were given to 30 subjects, one list each week; and the time was recorded for each of the 250 analogies. The mirror reading material consisted of prose selections, reading from right to left, printed in capitals, with punctuation marks omitted. The material was practically meaningless. Seven readings, in successive weeks, were made by each subject. Each reading consisted of 72 lines; time was recorded for each 12 lines. For the alphabet test, two complete alphabets, with each letter printed on a separate cardboard, were used. The 52 letters were arranged in random order for each trial, in two rows. The subject constructed a third row, making a complete alphabet in correct sequence, his time being recorded for this performance. The same subjects were used in all the tests. They were personally



selected from the student body of the University of Pittsburgh, and represent extreme cases of either good or poor scholastic ability.

A number of specific questions were in the mind of the experimenter in conducting the tests. The general question of whether practice tends to differentiate individuals or to make them more homogeneous was the principal one. Results were obtained by plotting curves, and by making correlations. Some of the correlations established were: between initial records and average records, and between initial performance and subsequent performance—two distinct things; between good and bad records and variability; between good and poor records and improvability; and between all of these results and intelligence. In addition to these findings, the investigation discloses something of the nature of the mental processes elicited by the tests.

*Results of Tests on Learning in Eighth Grade Pupils, and University Students with the Yerkes Multiple Choice Apparatus.* P. R. DAWSON & J. P. PORTER, Clark College.

The apparatus used was essentially the same as the earliest model of the Yerkes Multiple Choice apparatus, except that a small lamp is made to light up instead of the sounding of a buzzer, when the correct key is pressed. One hundred and twenty-two eighth-grade pupils and eighty university students have served as subjects. With each subject the four relations—first key to the left, second from the right, alternating first on left and first on the right, and the middle key—were used. The subject was often asked for introspections. Each subject was instructed to state the relation which was being used just as soon as he was certain he had learned it. This apparatus and the method thus far used would seem to be of promise in measuring rate and methods of learning to a large degree independently of the use of language by the subject. We find then in these tests very favorable conditions for the experimental study of the effect of definite mental attitudes and ideas. The hand often hovers over the correct key to be moved at the last second by the conscious voluntary choice of the subject and then presses the wrong key. The movement of the hand often proves to be right while the conscious discrimination is yet uncertain or mistaken. Statistical results on this point are not yet available. "Intelligence quotients" have been computed in the usual way for groups of the eighth-grade pupils. Some pupils had previously been promoted from Room 9 to Room 10. Some had been allowed

to add German to their schedule if they were given high rank by the teacher. More from these two groups stand higher also in "intelligent quotient" rank than from the group of whose ability the teacher's estimate is not so favorable. A measure of learning ability may be found in the ratio of the quotients of test 2 with those of test 1, those of test 3 with test 2, etc. There may be a positive correlation not only of these ratios with total test rating but also with school grades and the teacher's estimate. Aside from definite quantitative results this apparatus and method of experimentation do give us very favorable conditions for more adequate analysis of the learning process.

*Norms of Irregularity, on Point and Stanford Scales, for Normal and Feeble-minded Children, and Deteriorated (Insane) Cases.* S. L. PRESSEY, University of Indiana.

The paper is a brief summary of about two years' study (made largely at the Boston Psychopathic Hospital, but being continued at Indiana University) of differences in the make-up of examinations, at the same mental ages, obtained from different types of cases: Exact methods for the statement of irregularity, on both point and Binet scales, have been developed. On the point scale, averages were worked out for normal and feeble-minded children, feeble-minded adults, and for dementia præcox and chronic alcoholic patients. Analogous figures for the Stanford scale with normal and feeble-minded children, and normal and feeble-minded adults, have also been secured. A greater irregularity has been taken to mean a difference in the make-up of the score, and thus called for analysis by test; for each group the record on each test of the scales has been found.

Irregularity is, with all the groups, fairly constant at the different mental ages. On both scales the adult feeble-minded show a greater irregularity than normal or feeble-minded children. Analysis shows that the examinations obtained from adults differ markedly in make-up from the examinations of the normal children (on whom the scales were standardized) of the same mental age. The unsatisfactoriness of these scales for work with adults would seem demonstrated. For more than a very rough indication of mental status in adult defectives, tests and methods especially planned for such work are needed.

The psychotic cases gave an irregularity even greater than that shown by the adult feeble-minded. Analysis shows that here again

certain tests are most affected. These tests were grouped to make a special differential unit; the irregularity in these tests alone gave results of considerable differential value in distinguishing deterioration from primary amentia.

A higher irregularity was noticed also in cases of malingering, handicap in the examination because of physical illness, emotional disturbance, and illiteracy. Irregularity may thus give an indication as to the reliability of an examination—its freedom from such factors as those mentioned above.

It is argued in conclusion that irregularity, as a statement of the make-up of a score on a psychological examination, is second in importance only to the total of that score; an exact statement of the irregularity should be part of the findings for every examination.

*The Rank-Tangential Coefficient.* B. RUMI, Carnegie Institute of Technology.

In much practical work, where mental tests are used as the basis for the diagnosis of intelligence, the end desired is the breaking up of a large group of individuals into smaller groups, each of which will contain individuals of similar ability. The knowledge of two facts is necessary in order to make such a selection intelligently: first, one must know the percentage that should be selected in order that the least possible error be made; and second, one must have an index of the efficiency of selection at the preferred percentage.

The rank-tangential coefficient is an index of the efficiency of selection for any division of the total group. It is designated by the letter  $t$ , and is computed by the formula,

$$t = \frac{M(N + 1) - 2\Sigma(R_x)}{M(N - M)},$$

where  $N$  is the number of cases in the total group,  $M$  is the number of cases that are selected, and  $\Sigma(R_x)$  is the sum of the ranks in variable  $X$  of the  $M$  best or worst individuals in variable  $Y$ . The best individual is given rank 1; and the denominator is taken positive if good individuals are selected, and negative if poor individuals are selected. The  $Y$  variable is the instrument of selection and the  $X$  variable is the criterion by which the success of selection is to be judged.

The rank-tangential coefficient has several properties which recommend it as an index:

1. It varies between  $+1$  and  $-1$ , taking these values only in cases of perfect selection. It is equal to 0 for selection such as would in the long run be expected by chance.

2. The rank-tangential coefficient measures the relation in much the same terms as the product-moment coefficient of correlation, and in certain special cases these coefficients are the same.

3. The rank-tangential coefficient describes a property of tests, knowledge of which is important in the judgment of diagnostic value, and in the making of the diagnosis.

4. The rank-tangential coefficient is computed with great ease.

*Some Spatial Relations Tests.* L. L. THURSTONE, Carnegie Institute of Technology.

These tests are intended to tap the ability to think in three dimensional terms. The tendency toward bi-modality in the distributions may be taken as one form of evidence that space thinking belongs in the category of special abilities rather than in that of general intelligence. Record scores have been made by very young subjects while other subjects who score high in the general intelligence tests fail entirely in the spatial relations tests.

The Hand Test requires the subject to specify for each of forty-nine pictures of hands whether it represents a left hand or a right hand. Spatial Relations Test A requires the subject to imagine a lozenge shaped card turned and fitted into one of several possible outlines. Spatial Relations Test B is a variation of the preceding test. The Kinematics Test requires the subject to trace the direction of motion of machine parts, including spur gears, bevel gears, belts, and worm gears. The Punched Paper Test requires the subject to specify the location of holes punched through folded paper.

*Serial Mental Tests of Epileptic and Normal Children.* J. E. W. WALLIN, Psycho-Educational Clinic and Special Schools, St. Louis.

A set of 12 different tests (administered so as to constitute 16 separate tests), arranged in five consecutive series approximately equal in difficulty, were given as group tests every 28 days during five months to squads of epileptic and normal school children. The tests were designed to measure the strength of a variety of mental traits, and the amount of change which might take place in these traits during the time of the experiment.

Based on the averages for the five monthly series the efficiency of the epileptics varied in the different tests from 15 per cent. to 80 per cent. of the normals' efficiency. Their average efficiency in all the tests was 48 per cent. of normal efficiency. In half of the tests they did less than 35 per cent. as well as the normal. They did relatively better in the simpler, sensory and motor tests than in the more complex, intellectual tests.

The epileptics did relatively better in the amount of improvement made during the experiment. They gained 64 per cent. as much as the normal pupils. In relative amount of improvement (the gain expressed as a per cent. of the efficiency scores) the epileptics gained more than the normals in most of the tests. This was due to the low initial scores made by the epileptics.

Judged by the records of the normal squad, the epileptics ranked lowest in pedagogical efficiency (35 per cent. of normal). They graded decidedly lower by the monthly group tests than by the Binet-Simon, partly due to the greater difficulty of the epileptics to respond in writing than in speaking. But the group tests probably gave a truer measure of their intellectual level than the Binet-Simon.

*The Use of Mental Tests in Selecting Pupils for a Gifted Class.*

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At Urbana, Illinois, fifteen fifth-grade and fifteen sixth-grade pupils, selected by the principal and teachers "on the records made in their school work, their health, industry and application," were, in October, 1916, placed in a special class, where, when permitted to proceed to the extent of their ability, they succeeded, with certain exceptions, in accomplishing in the one year, two years of work. During this time these pupils were given a thorough Binet examination, followed by 64 other mental and educational tests. Of these 64, 50 were group tests and of them, 27 were also given, for purposes of comparison, to the control group—the pupils remaining in the two grades from which the special group had been drawn, while to a limited number in the control group were also given the 14 individual tests.

It would seem that this survey of the mental and pedagogical abilities of a group of pupils is as elaborate and thoroughgoing as any that has been reported, and on that account ought to yield significant results. We have been able, indeed, (1) to sort our tests



into three groups, (a) those of high worth, (b) those of medium worth, (c) those of practically no worth in selecting a group of gifted pupils. (2) We have shown that certain pupils had been wrongly placed in the special group, whereas other pupils had been wrongly retained in the control group, and that these mistakes would have been reduced virtually to zero had the pupils been selected by mental tests instead of by the school authorities and their classroom records. (3) We have found that some mental tests may have high value for differentiating degrees of ability within a group of gifted children that have only medium value in separating the group as a group from other pupils. (4) We have been able to draw up a series of percentile tables that will show the expected distribution of performance for pupils of the fifth and of the sixth grade in each of 27 tests. Finally, (5) we have been able by the results of our tests to make a fairly detailed analysis of the abilities of each of the pupils in our special group (including, it might be said, a child with an I. Q. of 167), and this analysis has been, and will continue to be, of very real service to the parents and teachers of these pupils.

All in all, the outcome ought to strengthen the conviction that mental tests possess marked significance for educational administration and also the conviction that gifted children can be, and should be, segregated in special classes in our public school systems.

